Methods And System For Bio-Intelligence From Over-The-Counter Pharmaceutical Sales

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Abstract

An analysis and unusual event detection method is presented herein that was developed systematically for bio-intelligence in the area of syndromic surveillance using over-the-counter (OTC) pharmaceutical sales data. First, a measurement scheme was defined. It bases on historical sales records and a set of derived seasonally varying reference lines. The relative deviation (RD) of the current daily medicine sales data from the reference lines, the n-days cumulation of the relative deviations, and the daily change of the relative deviations are calculated. Second, a dynamic system model for categorized public health status was developed and described by a set of state variables and state transitions. State transitions are determined by a rule system. The combination of the quantitative measurements listed above establishes the supporting set for the rule system. Therefore, the dynamic change of public health status is systematically modeled over time and space by rule-system-driven state transitions. Certain system states represent unusual events and can be fully described through this methodology.

Reference

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Linear System Theory, The State Space Approach
Zadeh, Lofti A., Desoer, Charles A. (1963), McGraw-Hill Book Company

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Claims

What is claimed is:

1. (Currently amended) A system for detecting an unusual public health status and for modeling the change of categorized public health status from over-the-counter (OTC) pharmaceutical sales data, comprising an apparatus with:

   A measurement scheme defined by a set of variables and calculations of categorized daily OTC sales data in a specified geographical scale;

   An algorithm for unusual public health status (or event) detection incorporating seasonally varying reference lines, and calculating three structural components from the input data: a daily deviation from the reference line, an n-days-cumulated-deviation, and the change of the daily deviations in that area;

   A dynamic system model describing the categorized public health status by a set of state variables, and the change of the public health status by ~~the~~ state transitions, ~~the~~ input sets, ~~the~~ output sets, and the rule systems that govern them;

   A~~The~~ rule system determines the state transitions for modeling the dynamic change of public health status through the analysis of information derived from OTC pharmaceutical sales in that area;

   A rule system combines the structural components incorporating the confidence supporting sets as the input variables;

   A rule system maps the state history to the output variables.

2. (Currently amended) The apparatus as claimed in Claim 1, wherein said measurement scheme includes the calculation of monthly (or weekly, or daily, or seasonally) averaged daily sales for the categorized OTC medicines as a ~~the~~ base line, from the data in the past at the same place, which is one data set (base line) for supporting the rule system.

3. (Currently amended) The apparatus as claimed in Claim 1 or Claim 2, wherein said measurement scheme includes the calculation of the deviation of daily sales in the current-month from a~~the~~ base line, and it is measured in change of percentage at the same place, which is another data set (the first structural component) for supporting the rule system.

4. (Currently amended) The apparatus as claimed in Claim 1 or Claim 3, wherein said measurement scheme includes the calculation of the n-days-cumulated-deviation (the deviation of daily sales from the base line), which is another data set (the second structural component) for supporting the rule system.

5. (Currently amended) The apparatus as claimed in Claim 1 or Claim 3, wherein said measurement scheme includes the calculation of the daily change of the deviation, which is another data set (the third structural component) for supporting the rule system.

6. (Currently amended) The apparatus as claimed in Claim 1, wherein said event detection algorithms are a rule system with supporting sets from the results in any of Claim 2, 3, 4 or ~~and~~ 5.

7. (Currently amended) The apparatus as claimed in Claim 1, wherein said a dynamic model of the categorized public health status is defined by the system with a set of state variables and state transitions over the time dimension at a specified place, with which state transitions model the change of the categorized public health status in that place.

8. (Currently amended) The apparatus as claimed in Claim 7, wherein said set of state variables to model public health status at a specified place, comprises ~~are~~ healthy status, critical status, starting-unusual status, upward-trend-unusual status, peak-unusual status, downward-trend status, and ending-unusual status.

9. (Currently amended) The apparatus as claimed in Claim 1 or~~and~~ Claim 7, wherein said state transitions over time at a specified place, further comprising ~~are a the~~ mathematical descriptions on how the categorized health status changes from one state variable to another state variable as time advances. The example time unit is daily.

10. (Currently amended) The apparatus as claimed in Claim 1, wherein said input variables ~~sets~~ are the mapped supporting sets for the state transition rule systems; the structural components are ~~it is~~ mapped ~~from the structural components~~ incorporating their confidence levels.

11. (Currently amended) The apparatus as claimed in Claim 10, ~~wherein said input sets are the supporting sets for the state transition rule systems and are mapped from the structural components incorporating the confidence levels,~~ where the mapped confidence levels are derived from the historical data sets, and the confidence supporting sets are found from the cumulated distribution functions with the specified confidence levels.

12. (Currently amended) The apparatus as claimed in Claim 1, wherein said output sets are a set of vectors, each with three values: likelihood, trend indicator, and impact indicator, where the output sets are mapped from the state variable history at the study place.

13. (Currently amended) The apparatus as claimed in Claim 1, wherein said rule system that governs the state transitions is the system with sets of logical rules, which evaluate both the logical and numerical functions to determine the system states and state transition.

14. (Original)The apparatus as claimed in Claim 1, wherein said rule system that processes the structural components is a rule system with both logical and numerical functions mapping the structural components to supporting sets.

~~15.~~15.(Currently amended) The apparatus as claimed in Claim 1, wherein said rule system that maps the state history to the output variables is a rule system, with both logical and numerical functions mapping the state variables to the output variables. ~~The output variables are described in Claim 12.~~